06-28-07

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Attorney Docket No. 801939-000101 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:
Lars Langemyr et al.

Confirmation No. 8229

Application No. 09/675,778

Art Unit: 2123

Filed: September 29, 2000

For: METHOD AND APPARATUS FOR THE SPECIFICATION AND AUTOMATIC DERIVATION OF PARTIAL DIFFERENTIAL EQUATIONS ASSOCIATED WITH COUPLED PHYSICAL QUANTITIES IN A MULTIPHYSICS PROBLEM

Examiner: Ayal I. Sharon

TRANSMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

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Dated: June 27, 2007 Signature: _____
(Joanna Pinos)

Dear Commissioner:

Submitted herewith is the Applicants' Appeal Brief Pursuant To 37 C.F.R. § 41.37 in support of the Notice of Appeal filed on March 28, 2007. Please charge the amount of $500, in accord with 37 C.F.R. § 41.20(b)(2), for the fee due to file a brief in support of an appeal, to Deposit Account No. 50-4181 (Attorney Docket No. 801939-000101).

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APPEAL BRIEF PURSUANT TO 37 C.F.R. § 41.37

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Dated: June 27, 2007 Signature: _____
(Joanna Pinos)

Dear Commissioner:

This appeal brief is filed pursuant to the Applicants' appeal to the Board of Patent Appeals and Interferences ("Board") from the final rejection of claims 1, 3-87 and 89-101 in an Office action mail dated September 29, 2006 and an Advisory Action Before the Filing of an Appeal Brief mail dated May 29, 2007, for the above-referenced application.

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Pursuant to 37 C.F.R. § 41.37(e), a Petition For Extension Of Time Under 37 C.F.R. § 1.136 is submitted herewith for a one-month extension of time. Please charge the amount of $120 as set forth in the petition.

Should any additional fees be required (except for payment of the issue fee) or should any credits for overpayment be due, the Commissioner is authorized to accordingly deduct or credit the fees to the aforementioned deposit account.

Respectfully submitted,

Dated: June 27, 2007

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1. REAL PARTY IN INTEREST

The real party in interest is COMSOL, Inc., a corporation having offices at 1 New England Executive Park, Suite 350, Burlington, Massachusetts 01803, and COMSOL AB, a company having offices at Tegnérgatan 23, SE-111 40 Stockholm, Sweden.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

3. STATUS OF CLAIMS

Claims 1, 3-87 and 89-101 are pending and have been finally rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Claims 2 and 88 were previously cancelled. It is from the final rejection of claims 1, 3-87 and 89-101, as submitted in the Appendix herewith, that this appeal is taken.

4. STATUS OF AMENDMENTS

Applicants' filed an Amendment on May 7, 2007 in response to the final Office action mail dated September 29, 2006 and the Notice of Appeal filed on March 28, 2007. Independent claims 1, 42, 82 and 92 were amended in the May 7, 2007 filing to clarify that the claimed invention relates to a mathematical model of a physical system in which the model has numerical values that represent physical aspects of the physical system. The Examiner entered the amendments in an Advisory Action Before the Filing of an Appeal Brief, dated May 29, 2007.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention is generally directed to a method executed in a computer apparatus (claims 1 and 82), or a computer readable medium having stored thereon instructions (claims 42 and 92) for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of, a combined set of partial differential equations (claims 1 and 82), or in terms of, combining or solving a set or system of partial differential equations (claims 42 and 92). (See, e.g., elements 10 and 14a-n in FIG. 1; element 19 in FIG. 2; page 1, lines 13-14, 24-26; page 2, lines 21-23; page 10, lines 1-20; page 11, line 12 – page 12, line 12; page 15, lines 5-10). The present invention allows engineers

to model the response of a physical system without having to build the actual system, which can result in significant cost and design efficiencies.

Independent claim 1 comprises representing at least one of a plurality of systems as two or more selected application modes modeling physical quantities of one of the plurality of systems (e.g., element 200 in FIG. 22; page 22, lines 1-12; page 56, lines 8-22; page 58, lines 13-15; page 59, lines 11-19; page 61, lines 1-17; page 63, line 19 – page 64, line 16). A set of partial differential equations is determined for each of the two or more selected application modes (e.g., elements 210, 222, 224 and 226 in FIG. 22; page 38, lines 1-15; page 57, lines 1-14). Parameters of the partial differential equations are physical quantities of corresponding ones of the plurality of systems (see, e.g., page 15, lines 6-22). The combined set of partial differential equations are formed using the determined sets of partial differential equations associated with the one of the plurality of systems (see, e.g., page 15, line 6 – page 16, line 10; page 58, line 17 – page 59, line 9). A model of the combined physical system is output based on the combined set of partial differential equations for the two or more selected application modes for the one of the plurality of systems (see, e.g., page 48, line 14 – page 49, line 7). The model represents a mathematical expression of the physical quantities of the combined physical system (see, e.g., page 15, line 6 – page 16, line 10; page 18, lines 9-18).

Independent claim 42 comprises machine executable code which, when executed by at least one processor, causes the processor to perform steps generally comprising those outlined above for independent claim 1 (see, e.g., page 10, lines 1-20). However, claim 42 does not necessarily require that the combined set of partial differential equations are formed using the determined sets of partial differential equations associated with the one of the plurality of systems. Claim 42 more broadly comprises combined sets of partial differential equations formed using sets of partial differential equations associated with the one of the plurality of systems (e.g., page 14, line 13 – page 15, line 22).

Independent claim 82 comprises defining a plurality of user-defined application modes modeling physical quantities of an associated model (e.g., element 200 in FIG. 22; page 56, lines 8-22; page 61, lines 1-17; page 59, lines 11-19; page 60, lines 14-17; page 63, line 19 – page 64, line 16). Two or more of the user-defined application modes are selected (e.g., elements 210, 212 and 226 in FIG. 22; page 56, lines 10-11; page 58, lines 13-15; page 60, lines 14-17). Sets of partial differential equations are determined for the selected two or more user-defined

application modes of the associated model (e.g., elements 210, 222, 224 and 226 in FIG. 22; page 22, lines 1-12; page 38, lines 1-15; page 57, lines 1-14; page 60, lines 14-17). Parameters of the partial differential equations are physical quantities of an associated model (e.g., element 214 in FIG. 22; page 57, lines 1-5). A model is output based on a combination of the determined sets of partial differential equations for the two or more selected user-defined application modes for the associated model (e.g., elements 230 and 232 in FIG. 23; page 58, line 17 – page 59, line 9; page 60, lines 14-17). The model represents physical quantities of the combined physical system (e.g., page 18, lines 9-18; element 110 in FIG. 7; element 230 in FIG. 23; page 57, lines 1-14).

Independent claim 92 comprises machine executable code which, when executed by at least one processor, causes the processor to perform steps generally comprising those outlined above for independent claim 82 (see, e.g., page 10, lines 1-20) with the following exception. Claim 82 comprises parameters of the partial differential equations being physical quantities of an associated model (e.g., elements 214 and 222 in FIG. 22; page 57, lines 1-14). Claim 92 comprises parameters of the partial differential equations being physical quantities of corresponding systems (see, e.g., element 110 in FIG. 7; page 15, lines 6-22). Furthermore, claim 82 comprises the model representing physical quantities of the combined physical system (e.g., page 57, lines 1-14), whereas claim 92 comprises the model representing a mathematical expression of the physical quantities of the combined physical system (see, e.g., page 15, line 6 – page 16, line 10).

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claims 1, 3-87 and 89-101 are patentable subject matter under 35 U.S.C. § 101 that provide a concrete, useful and tangible result.

7. ARGUMENT

The Applicants' argument includes discussion of: (1) the present invention, (2) the general case law on patentable subject matter, (3) the reasons why a *prima facie* case of non-statutory subject matter has not been established for any of the pending claims, and (4) the reasons why the pending claims are patentable subject matter that provide a concrete, useful and tangible result.

I. Present Invention

Instructions on a computer readable medium or methods executed in a computer apparatus of the present invention are used to create a model of a physical system having several concrete, useful and tangible outcomes such as:

(a) modeling transmission signals with frequencies in the microwave range as may be used in the telecom industry (e.g., page 67, lines 15-17); and

(b) modeling physical systems involving, for example, one or more of the following disciplines:

- structural mechanics (e.g., page 16, lines 15-16; page 47, lines 9-11);
- acoustics (e.g., page 16, line 13);
- chemical reactions (e.g., page 16, line 14);
- diffusion (e.g., page 16, line 14);
- electromagnetics (e.g., page 16, line 14);
- fluid dynamics (e.g., page 16, line 14);
- geophysics (e.g., page 16, line 14);
- heat transfer (e.g., page 16, line 15; page 19, lines 9-10);
- porous media flow (e.g., page 16, line 15);
- semiconductor devices (e.g., page 16, line 15); and
- wave propagation (e.g., page 16, line 16).

The techniques described in the application are useful for modeling and simulations using a computer system, without the need to build the physical system that is being modeled (see, e.g., page 1, lines 13-14). Certain embodiments of the present invention include a computer system or a computer program executed on a host computer (e.g., page 10, lines 2-3; page 11, lines 14-15). Other embodiments of the present invention include a user interface such as a graphical user interface for specifying a multiphysics system that includes, for example, a heat transfer and other application modes (e.g., elements 30 and 32 in FIG. 3; page 18, lines 9-18, page 19, lines 8-17).

II. General Law on Patentable Subject Matter

Section 101 of Title 35 of the United States Code provides:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefore, subject to the conditions and requirements of this title.

35 U.S.C. § 101 (1952).

The Supreme Court has recognized that Congress chose expansive language for section 101 to include "anything under the sun that is made by man" as statutory subject matter. M.P.E.P. § 2106 *citing Diamond v. Chakrabarty*, 447 U.S. 303, 308-09, 206 U.S.P.Q. 193, 197 (1980). The Federal Circuit further recognizes that the "use of the expansive term 'any'... represents Congress's intent not to place any restrictions on the subject matter for which a patent may be obtained beyond those specifically recited in section 101." *In re Alappat*, 33 F.3d 1526, 1542, 31 U.S.P.Q.2d 1545, 1556 (Fed. Cir. 1994) (emphasis added). There are, however, "three categories of subject matter for which one may not obtain patent protection, namely 'laws of nature, natural phenomena, and abstract ideas.'" *Id. quoting Diamond v. Diehr*, 450 U.S. 175, 185. n18, 209 U.S.P.Q. 1, 7 (1981). In summary, notwithstanding the exceptions of *Diehr*, "any new and useful process, machine, manufacture or composition of matter under the sun that is made by man is the proper subject matter of a patent." M.P.E.P. § 2106.

The United States Patent and Trademark Office ("USPTO") recognizes that "computer programs embodied in a tangible medium...are patentable subject matter under 35 U.S.C. § 101". *In re Bearegard*, 53 F.3d 1583, 1584, 35 U.S.P.Q.2d 1383 (Fed. Cir. 1995). Furthermore, both this Board and the Federal Circuit recognize as patentable subject matter a "memory containing stored information" even where the stored data "exist as a collection of bits having information about the relationship between [attribute data objects] ADOs." *See In re Lowry*, 32 F.3d 1579, 1582-83, 32 U.S.P.Q.2d 1031 (Fed. Cir. 1994). It is also recognized that "any step-by-step process, be it electronic, chemical, or mechanical," involve algorithms in the broad sense of the term and that "judicial proscription against patenting a 'mathematical algorithm'...is narrowly limited to mathematical algorithms in the abstract. *AT&T Corp. v. Excel Commc'ns, Inc.*, 172 F.3d 1352, 1355-56, 50 U.S.P.Q.2d 1447 (Fed. Cir. 1999). Thus, a process that applies a mathematical algorithm to a new and useful end "is at the very least not barred at the threshold by § 101." *Id.* at 1357 *citing Diehr*, 450 U.S. at 185, 209 U.S.P.Q. at 7 (emphasis added).

An inquiry into patentable subject matter requires examining whether a mathematical concept has been reduced to some practical application that renders it "useful." *Apallat*, 33 F.3d at 1544, 31 U.S.P.Q.2d at 1557 (claim held to be more than an abstract idea where the claimed invention as a whole was directed toward forming a specific machine that produced a useful, concrete and tangible result of a waveform display). Where a claimed process applies a mathematical algorithm to produce a useful, concrete and tangible result without preempting

other uses of the mathematical principle, the claimed process comfortably falls within the scope of section 101. *AT&T*, 172 F.3d at 1358, 50 U.S.P.Q. 1447. Therefore, the "mere fact that a claimed invention involves inputting numbers, calculating numbers, outputting numbers, and storing numbers, in and of itself, would not render [the claim] nonstatutory subject matter, unless, of course, its operation does not produce a 'useful, concrete and tangible result.'" *State Street Bank & Trust Co. v. Signature Fin. Group, Inc.*, 149 F.3d 1368, 1374, 47 U.S.P.Q.2d 1596 (Fed. Cir. 1998) *citing Alappat*, 33 F.3d at 1544, 31 U.S.P.Q.2d at 1557 (emphasis added); *see also AT&T*, 172 F.3d at 1359.

A deficiency in the utility prong of section 101 also creates an enablement problem under 35 U.S.C. § 112, ¶1. *See* M.P.E.P. § 2107.01 *citing In re Brana*, 51 F.3d 1560, 1564 n.12, 34 U.S.P.Q.2d 1436 (Fed. Cir. 1995); *In re Fouche*, 439 F.2d 1237, 1243, 169 U.S.P.Q. 429, 434 (CCPA 1971) ("If such compositions are in fact useless, appellant's specification cannot have taught how to use them."). As explained further, "the how to use prong of section 112 incorporates as a matter of law the requirement of 35 U.S.C. § 101 that the specification disclose as a matter of fact a practical utility for the invention. *In re Ziegler*, 992 F.2d 1197, 1200, 26 U.S.P.Q.2d 1600 (Fed. Cir. 1993).

The Examiner, of course, has the initial burden of establishing a *prima facie* basis to deny patentability to a claimed invention under any statutory provision. *In re Mayne*, 104 F.3d 1339, 1341, 41 U.S.P.Q.2d 1451, 1453 (Fed. Cir. 1997). In rejecting a claim under 35 U.S.C. § 101, the *prima facie* showing by the Examiner must be set forth in a well reasoned statement that includes a detailed explanation why the claimed invention has no specific and substantial credible utility. M.P.E.P. § 2107.02. Statements made by the applicant incident to prosecution of the application cannot form the sole basis for a lack of utility rejection under section 101. M.P.E.P. § 2107.02 *citing Tol-O-Matic, Inc. v. Proma Produkt-Und Mktg. GmbH*, 945 F.2d 1546, 1553, 20 U.S.P.Q.2d 1332, 1338 (Fed. Cir. 1991) *overruled on other grounds by Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 974, 34 U.S.P.Q.2d 1321 (Fed. Cir. 1995). If the Examiner determines that an asserted utility is not specific or substantial, "a *prima facie* showing must establish that it is more likely than not that a person of ordinary skill in the art would not consider that any utility asserted by the applicant would be specific and substantial." M.P.E.P. § 2107.02. The *prima facie* showing must contain the following elements:

(A) An explanation that clearly sets forth the reasoning used in concluding that the asserted utility for the claimed invention is neither both specific and substantial nor well-established;

(B) Support for factual findings relied upon in reaching this conclusion; and

(C) An evaluation of all relevant evidence of record, including utilities taught in the closest prior art.

M.P.E.P. § 2107.02.

Claims 1, 2-87 and 89-101 were rejected under 35 U.S.C. § 101 for lacking a concrete, useful, and tangible result, and for being broadly directed to an abstract idea. For at least the reasons stated below, the Applicants respectfully request reversal by the Board of this erroneous rejection.

III. A *Prima Facie* Case Of Non-Statutory Subject Matter Has Not Been Established With Respect To Any Of The Rejected Claims

The Examiner first raised the 35 U.S.C. § 101 rejection in a non-final Office action mail dated January 25, 2006. Among numerous other rejections that were subsequently withdrawn[1], the Office action rejected all the pending claims under section 101 by summarily asserting that they "do not produce a tangible result." (January 26, 2006 Office action, page 4). The Examiner provided no analysis other than citing what the Examiner should have shown (but did not) under the USPTO "Interim Guidelines for Examination of Patent Applications for Subject Matter Eligibility." (January 26, 2006 Office action, pages 2-4). The Applicants filed an Amendment on July 25, 2006 responding to the Examiner's rejection. Independent claims 1, 42, 82 and 92 were amended in response to the rejection to more clearly recite "a tangible result, i.e., the output of a model." (July 25, 2006 Amendment, page 18).[2]

The Examiner maintained the 35 U.S.C. § 101 rejection in a final Office action mail dated September 12, 2006. Again, the Examiner merely offered conclusory allegations[3] without

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[1] The January 25, 2006 Office action raised several other issues including rejections under 35 U.S.C. §§ 102, 103 and 112. (January 25, 2006 Office action, pages 6-36; September 12, 2006 Office action, pages. 4-5 and 8).

[2] The Amendment further recited that:

> The output of a generated model to solve a scientific and engineering problem or problems is clearly a beneficial result or effect. By way of example only, the generation of such a simple exemplary model for addressing problems with the transmission of frequencies in the microwave range in a waveguide for the telecom industry is discussed on pages 67-73.

(July 25, 2006 Amendment, page 18).

[3] The September 12, 2006 Office action summarily asserts that the pending claims "do not produce a tangible result"; the "instant application [is] directed to an abstract idea"; the "claims are so broad as to preclude every practical application of the idea"; the "claims lack a concrete, useful, and tangible result"; and that the claims "produce a mathematical 'model', which is so broadly defined that it lacks utility and tangibility." (September 12, 2006 Office action, pages 4-7).

any significant analysis. (*See* September 12, 2006 Office action, pages 4-7). However, the Examiner must set forth in a well reasoned statement, including a detailed explanation, why the claimed invention has no specific or substantial utility. *See* M.P.E.P. § 2107.02. Furthermore, the Examiner's *prima facie* showing must contain an evaluation of all relevant evidence of record, including utilities taught in the closest prior art. *Id.* In addition to a lack of detailed explanation, the Examiner has failed to use any prior art of record as support for his rejection under section 101.[4] Rather, the Examiner seems to rely heavily on the Applicants' statements in the July 25, 2006 Amendment as support for the erroneous rejections. (*See* September 12, 2006 Office action, pages 5-6). However, the Examiner's attempt to rely on the Applicants' statement appears misguided since statements made incident to prosecution cannot be the sole basis for a lack of utility rejection. *See Tol-O-Matic*, 945 F.2d at 1553, 20 U.S.P.Q.2d at 1338.

In a subsequent Advisory Action dated May 29, 2007, the Examiner entered, but did not allow, additional claim amendments filed by the Applicants on May 7, 2007. The Advisory Action maintains the Examiner's conclusory assertion that the "claims attempt to preclude every substantial practical application of an idea" and "are directed to an abstract idea." (May 29, 2007 Advisory Action). Furthermore, the Advisory Action fails to cite any prior art of record in support of the section 101 rejection. (*See id.*) Furthermore, the Examiner, again, appears to improperly rely on the Applicants' asserted utility without providing any detailed explanation why the claimed invention has no specific or substantial utility.

For at least the foregoing reasons, the Examiner has failed to establish a *prima facie* case that the pending claims lack utility. Thus, the rejection based on 35 U.S.C. § 101 should be reversed and the final claim amendments should be allowed.

IV. Independent Claims 1 And 82 Along With Their Dependent Claims Are Patentable Subject Matter That Produce Tangible And Non-Abstract Results

Pending independent claims 1 and 82 include, *inter alia*, a method executed in a computer apparatus for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of a combined set of partial differential equations. Claims 1 and 82 further comprise outputting a model of the combined physical system whereby the model represents a mathematical expression of the physical quantities of the combined physical system. In addition, claims 10, 13, 14 and

[4] The prior art of record includes several non-patent publications including product documentation for the FEMLAB 1.0 product, which is published by the real party of interest in this matter, COMSOL.

26, which depend from independent claim 1, add further limitations, such as, displaying a partial differential equation, obtaining data from a graphical user interface, using a graphical user interface to display and input data, or storing input data in a memory of a computer system.

The Examiner improperly alleges that independent method claims 1 and 82, along with their dependent claims, are so broadly defined as to lack utility and tangibility and further represent an abstract idea. However, this Board and the Federal Circuit have recognized that any step-by-step process, including those involving electronics (e.g., computer-based), has algorithms and that any limitation on the patenting of these algorithms should only occur for mathematical algorithms in the abstract. *See AT&T*, 172 F.3d at 1355-56, 50 U.S.P.Q.2d 1447. Processes that apply a mathematical algorithm to a new and useful end should not be barred at the threshold by section 101. *See id.* at 1357 *citing Diehr*, 450 U.S. at 185, 209 U.S.P.Q. at 7 (emphasis added).

The claimed invention allows engineers to model, test, and predict the response of a physical system without the need for the system to be built. Independent claims 1 and 82 include such steps as outputting a model of a combined physical system and executing the method in a computer apparatus. Furthermore, the dependent claims add further limiting elements, such as, displaying an equation, obtaining data from a graphical user interface, or storing data in a memory of a computer system. All these claimed elements of the present invention go beyond a mathematical algorithm in the abstract and instead apply mathematical concepts to a new and useful end. As described in the specification, the claimed invention is useful for modeling transmission signals that may be used in the telecom industry (e.g., page 67, lines 15-17). Other useful applications may include modeling physical systems that involve, for example, one or more of the following disciplines: structural mechanics, chemical reactions, geophysics, porous media flow, and semiconductor devices. The method further outputs the model of the combined physical systems.

The claimed methods do not preempt every practical application of a mathematical algorithm as asserted by the Examiner. In fact, during the prosecution of the pending claims, several narrowing claim amendments were made to overcome anticipation and obviousness rejections based on prior art references cited by the Examiner. (*See* June 3, 2004 Office action, pages 32; May 25, 2005 Office action, pages 3-31; January 25, 2006 Office action, pages 7-36). This alone suggests that the claims are of a limited scope so as not to preclude every practical

application of the mathematical model of a physical system. As discussed in *AT&T*, a claimed process that applies a mathematical algorithm to produce a useful, concrete and tangible result (e.g., outputting a model of a physical system, displaying equations, obtaining data from a graphical user interface, or storing data) without preempting other uses of the mathematical principle, falls comfortably within the scope of section 101. *See* 172 F.3d at 1358, 50 U.S.P.Q.2d 1447. In fact, the *State Street* case, which the Examiner cites repeatedly as to whether a claimed invention produces a useful, concrete and tangible result (*see* September 12, 2006 Office action, pages 3, 6-7), affirmed the patentability of a claimed invention directed to the manipulation of numbers. *See State Street*, 149 F.3d at 1374, 47 U.S.P.Q.2d 1596.

For at least these reasons, independent claims 1 and 82 along with their dependent claims are patentable subject matter that produce tangible and non-abstract results. Therefore, the rejection based on 35 U.S.C. § 101 should be reversed and the final claim amendments should be allowed.

V. Independent Claims 42 And 92 Along With Their Dependent Claims Are Patentable Subject Matter That Produce Tangible And Non-Abstract Results

Pending independent apparatus claims 42 and 92 include, *inter alia*, a computer readable medium having stored thereon instructions for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of a combined set of partial differential equations (claim 42) or in terms of solving a set of partial differential equations (claim 92). The partial differential equations comprise machine executable code which when executed by at least one processor cause the processor to perform certain steps. The steps comprise outputting a model of the combined physical system whereby the model represents a mathematical expression of the physical quantities of the combined physical system. In addition, claims 50, 53, 54 and 66 which depend from independent claim 42 add further limitations, such as, displaying a partial differential equation, obtaining data from a graphical user interface, using a graphical user interface to display and input data, or storing input data in a memory of a computer system.

Similar to the discussion for independent method claims 1 and 82, the Examiner improperly alleges that independent apparatus claims 42 and 92, along with their dependent claims, are so broadly defined as to be non-statutory subject matter. As previously discussed, the USPTO recognizes that a computer program embodied in a tangible medium is patentable

subject matter. *See Bearegard*, 53 F.3d at 1584, 35 U.S.P.Q.2d 1383. It is also recognized that memory containing stored information is patentable subject matter. *See Lowry*, 32 F.3d at 1582-83, 32 U.S.P.Q.2d 1031.

The independent apparatus claims include instructions, that when executed on a processor, output a model of a combined physical system. Furthermore, the dependent apparatus claims add further limiting elements, such as, displaying an equation, obtaining data from a graphical user interface, or storing data in a memory of a computer system. Similar to the discussion of the pending method claims, the pending apparatus claims go beyond a mathematical algorithm in the abstract and instead apply mathematical concepts to a new and useful end. Furthermore, the apparatus claims were amended similar to the pending method claims to overcome, *inter alia*, anticipation and obviousness rejections based on prior art references cited by the Examiner. (*See* June 3, 2004 Office action, pages 32; May 25, 2005 Office action, pages 3-31; January 25, 2006 Office action, pages 7-36). The narrowing amendments during prosecution similarly suggest that the apparatus claims are of a limited scope so as not to preclude every practical application of the mathematical model of a physical system. Thus, in addition to the USPTO's recognition of a computer program embodied in a tangible medium being patentable subject matter, the pending apparatus claims also fall within the scope of section 101 because they do not preclude every practical application of a mathematical algorithm.

For at least these reasons, independent claims 42 and 92, along with their dependent claims, are patentable subject matter that produce tangible and non-abstract results. Therefore, the rejection based on 35 U.S.C. § 101 should be reversed and the final claim amendments should be allowed.

VI. The Examiner's Withdrawal Of An Enablement Rejection Is Probative Of The Utility Of The Claimed Invention

In the January 25, 2006 Office action, the Examiner rejected the claim invention based on lack of enablement under 35 U.S.C. § 112, ¶1. (January 25, 2006 Office action, pages 6-7). In that same Office action, the Examiner also rejected the same claimed invention under section 101. (*See id.* at 2-6). The Examiner withdrew the enablement rejection based on the arguments presented by the Applicants in the July 25, 2006 Amendment. (*See* September 29, 2006 Office action, page 8).

As discussed previously, a rejection under section 101 also creates an enablement problem. M.P.E.P. § 2107.01 *citing Brana*, 51 F.3d at 1564 n.12, 34 U.S.P.Q.2d 1436; *Ziegler*, 992 F.2d at 1200, 26 U.S.P.Q.2d 1600. The Examiner was persuaded by the Applicants' arguments that the same claims, which were also rejected under section 101, are enabled. (*See* September 29, 2006 Office action, page 8). The Examiner's agreement with the Applicants' enablement argument suggests that the Applicants likewise successfully demonstrated sufficient utility to overcome the section 101 rejection.

For at least this reason, independent claims 1, 42, 82 and 92 along with their dependent claims are patentable subject matter. Therefore, the rejection based on 35 U.S.C. § 101 should be reversed and the final claim amendments should be allowed.

8. CONCLUSION

For at least the reasons set forth above, the Applicants respectfully submit that all the pending claims define patentable subject matter under 35 U.S.C. § 101 and provide a concrete, useful and tangible result. Accordingly, the Applicants respectfully request the reversal of the 35 U.S.C. § 101 rejections of claims 1, 3-87 and 89-101.

Dated: June 27, 2007

Respectfully submitted,

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9. APPENDIX OF CLAIMS ON APPEAL

1. A method executed in a computer apparatus for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of a combined set of partial differential equations, the method comprising:

representing at least one of a plurality of systems as two or more selected application modes modeling physical quantities of said one of said plurality of systems;

determining a set of partial differential equations for each of the two or more selected application modes, parameters of the partial differential equations being physical quantities of corresponding ones of said plurality of systems;

forming said combined set of partial differential equations using the determined sets of partial differential equations associated with said one of said plurality of systems; and

outputting a model of said combined physical system based on said combined set of partial differential equations for the two or more selected application modes for the said one of said plurality of systems, whereby the model represents a mathematical expression of the physical quantities of the combined physical system.

3. The method of Claim 1, further comprising:

representing at least one of said physical quantities of a first of said plurality of application modes using at least one dependent variable in said set of partial differential equations corresponding to said first of said plurality of application modes.

4. The method of Claim 3, further comprising:

representing said at least one of said physical quantities directly as said at least one dependent variable.

5. The method of Claim 4, further comprising:

representing said at least one of said physical quantities using a relation between said at least one dependent variable and another variable representing said at least one physical quantity.

6. The method of Claim 5, wherein said at least one of said physical quantities is represented using at least one of: a numerical value and a mathematical expression.

7. The method of Claim 6, further comprising:

forming said mathematical expression including at least one of: a space coordinate, a time coordinate, a numerical value, and an actual physical quantity.

8. The method of Claim 1, further comprising:

associating at least one subdomain with each application mode.

9. The method of Claim 8, wherein each of said physical quantity is described by at least one physical property, and the method further comprising:

disabling at least one physical quantity and associated variables in a subdomain.

10. The method of Claim 1, further comprising:

displaying a partial differential equation in one of a: coefficient view and a general form corresponding to a representation of said partial differential equation; and

modifying a portion of said partial differential equation.

11. The method of Claim 10, further comprising: modifying at least one boundary condition of said partial differential equation.

12. The method of Claim 10, further comprising:

modifying at least one coefficient of said partial differential equation.

13. The method of Claim 10, further comprising:

obtaining data using a graphical user interface in connection with said one of said plurality of systems.

14. The method of Claim 10, further comprising:

using a graphical user interface to display and input data.

15. The method of Claim 1, further comprising:

solving said combined system of partial differential equations using a coefficient form of said combined set of partial differential equations.

16. The method of Claim 1, further comprising:

solving said combined set of partial differential equations using a general form of said combined system of partial differential equations.

17. The method of Claim 16, further comprising:

converting at least one set of partial differential equations included in said combined set of partial differential equations from coefficient to general form.

18. The method of Claim 17, further comprising:

converting said combined set of partial differential equations from coefficient to general form.

19. The method of Claim 18, further comprising:

using linearization of a general form to solve for a non-linear set of partial differential equations.

20. The method of Claim 19, further comprising:

using a Newton method in solving for said non-linear set of partial differential equations.

21. The method of Claim 1, further comprising:

solving said combined set of partial differential equations.

22. The method of Claim 21, wherein solving said combined set further includes:

selecting a portion of physical quantities in said combined set of partial differential equations;

solving for one or more variables associated with said portion of physical quantities.

23. The method of Claim 22, further comprising:

using values associated with physical quantities not included in said portion for specifying initial conditions.

24. The method of Claim 21, further comprising:

selecting a solver type specifying a particular technique used in solving said combined set of partial differential equations.

25. The method of Claim 24, wherein said solver type uses a finite element method.

26. The method of Claim 1, further comprising:

using a graphical user interface in connection with input data;

storing said input data in a representation in a data structure stored in a memory of the computer system; and

converting said input data into an intermediate form wherein said intermediate form for each set of partial differential equations associated with said one of said plurality of systems is used in forming said combined set.

27. The method of Claim 1, further comprising:

determining a submode setting associated with one of the sets of partial differential equations associated with said one of said plurality of systems; and

determining a number of variables included in said one set of partial differential equations in accordance with said submode setting and a type of a corresponding application mode.

28. The method of Claim 27, wherein said submode is one of stationary, time dependent, linear, non-linear, scalar and multi-component.

29. The method of Claim 1, further comprising:

selecting at least one application mode.

30. The method of Claim 29, wherein said at least one application mode is one of predefined and user defined.

31. The method of Claim 30, further comprising:

modifying a set of routines associated with a predefined application mode to be used in connection with a user defined application mode.

32. The method of Claim 1, wherein said one of said plurality systems being modeled is a one-dimensional geometry model.

33. The method of Claim 1, wherein said one of said plurality systems being modeled is a two-dimensional geometry model.

34. The method of Claim 1, wherein said one of said plurality of systems being modeled is a three-dimensional geometry model.

35. The method of Claim 31, further comprising:

defining a user-defined application mode.

36. The method of Claim 35, wherein said defining a user-defined application mode further comprises:

defining an object class corresponding to said user-defined application mode; and

defining a first portion of methods included in said object class using functionality that is inherited from other classes.

37. The method of Claim 36, further comprising:

overloading a second portion of methods to provide alternative functionality.

38. The method of Claim 37, further comprising:

using overloading in connection with at least one method to disable functionality of said at least one method.

39. The method of Claim 31, further comprising:

defining an application that is a subclass of an existing class corresponding to functionality of an application mode.

40. The method of Claim 39, wherein said application mode is user-defined.

41. The method of Claim 39, wherein said application mode is predefined.

42. A computer readable medium having stored thereon instructions for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of a combined set of partial differential equations comprising machine executable code which when executed by at least one processor, causes the processor to perform steps comprising:

representing at least one of a plurality of systems as two or more selected application modes modeling physical quantities of said one of said plurality of systems;

determining a set of partial differential equations for each of the two or more selected application modes, parameters of the partial differential equations being physical quantities of corresponding ones of said plurality of systems;

forming said combined set of partial differential equations using sets of partial differential equations associated with said one of said plurality of systems; and

outputting a model of said combined physical system based on said combined set of partial differential equations for the two or more selected application modes for the said one of said plurality of systems, whereby the model represents a mathematical expression of the physical quantities of the combined physical system.

43. The computer readable medium of Claim 42, further comprising:

representing at least one of said physical quantities of a first of said plurality of application modes using at least one dependent variable in said set of partial differential equations corresponding to said first of said application modes.

44. The computer readable medium of Claim 43, further comprising:

representing said at least one of said physical quantities directly as said at least one dependent variable.

45. The computer readable medium of Claim 44, further comprising:

representing said at least one of said physical quantities using a relation between said at least one dependent variable and another variable representing said at least one physical quantity.

46. The computer readable medium of Claim 45, wherein said at least one of said physical quantities is represented using at least one of: a numerical value and a mathematical expression.

47. The computer readable medium of Claim 46, further comprising:

forming said mathematical expression including at least one of: a space coordinate, a time coordinate, a numerical value, and an actual physical quantity.

48. The computer readable medium of Claim 42, further comprising:

associating at least one subdomain with each application mode.

49. The computer readable medium of Claim 48, wherein each of said physical quantity is described by at least one physical property, and the computer readable medium further comprises:

disabling at least one physical quantity and associated variables for a portion of a subdomain.

50. The computer readable medium of Claim 42, further comprising:

displaying a partial differential equation in one of a: coefficient view and a general form corresponding to a representation of said partial differential equation; and

modifying a portion of said partial differential equation.

51. The computer readable medium of Claim 50, further comprising:

modifying at least one boundary condition of said partial differential equation.

52. The computer readable medium of Claim 50, further comprising:

modifying at least one coefficient of said partial differential equation.

53. The computer readable medium of Claim 50, further comprising:

obtaining data using a graphical user interface in connection with said one of said plurality of systems.

54. The computer readable medium of Claim 50, further comprising:

using a graphical user interface to display and input data.

55. The computer readable medium of Claim 42, further comprising:

solving said combined set of partial differential equations using a coefficient form of said combined set of partial differential equations.

56. The computer readable medium of Claim 42, further comprising:

solving said combined set of partial differential equations using a general form of said combined set of partial differential equations.

57. The computer readable medium of Claim 56, further comprising:

converting at least one set of partial differential equations included in said combined set of partial differential equations from coefficient to general form.

58. The computer readable medium of Claim 57, further comprising:

converting said combined set of partial differential equations from coefficient to general form.

59. The computer readable medium of Claim 58, further comprising:

using linearization of a general form to solve for a non-linear system of partial differential equations.

60. The computer readable medium of Claim 59, further comprising:

using a Newton method in solving for said non-linear system of partial differential equations.

61. The computer readable medium of Claim 42, further comprising:

solving said combined set of partial differential equations.

62. The computer readable medium of Claim 61, wherein said solving said combined set further includes:

selecting a portion of physical quantities in said combined ~~system~~ set of partial differential equations; and

solving for one or more variables associated with said portion of variables.

63. The computer readable medium of Claim 62, further comprising:

using values associated with physical quantities not included in said portion for specifying initial conditions.

64. The computer readable medium of Claim 61, further comprising:

selecting a solver type specifying a particular technique used in solving said combined set of partial differential equations.

65. The computer readable medium of Claim 64, wherein said solver type includes solving a system of partial differential equations using a finite element method.

66. The computer readable medium of Claim 42, further comprising:

using a graphical user interface in connection with input data;

storing said input data in a representation in a data structure stored in a memory of the computer system; and

converting said input data into an intermediate form wherein said intermediate form for each set of partial differential equations associated with said one of said plurality of systems is used in forming said combined set.

67. The computer readable medium of Claim 42, further comprising:

determining a submode setting associated with one of the sets of partial differential equations associated with said one of said plurality of systems; and

determining a number of variables included in said one set of partial differential equations in accordance with said submode setting and a type of a corresponding application mode.

68. The computer readable medium of Claim 67, wherein said submode is one of stationary, time dependent, linear, non-linear, scalar and multi-component.

69. The computer readable medium of Claim 42, further comprising:

selecting at least one application mode.

70. The computer readable medium of Claim 69, wherein said at least one application mode is one of predefined and user defined.

71. The computer readable medium of Claim 70, further comprising:

defining a user defined application mode; and

modifying a set of routines associated with a predefined application mode to be used in connection with a user defined application mode.

72. The computer readable medium of Claim 42, wherein said one of said plurality systems being modeled is a one-dimensional geometry model.

73. The computer readable medium of Claim 42, wherein said one of said plurality systems being modeled is a two-dimensional geometry model.

74. The computer readable medium of Claim 42, wherein said one of said plurality of systems being modeled is a three-dimensional geometry model.

75. The computer readable medium of Claim 42, further comprising:

defining a user-defined application mode.

76. The computer readable medium of Claim 75, wherein said machine executable code for defining a user-defined application mode further comprises:

defining an object class corresponding to said user-defined application mode; and

defining a first portion of methods included in said object class using functionality that is inherited from other classes.

77. The computer readable medium of Claim 76, further comprising:

overloading a second portion of methods to provide alternative functionality.

78. The computer readable medium of Claim 77, further comprising:

using overloading in connection with at least one method to disable functionality of said at least one method.

79. The computer readable medium of Claim 42, further comprising:

defining an application that is a subclass of an existing class corresponding to functionality of an application mode.

80. The computer readable medium of Claim 79, wherein said application mode is user-defined.

81. The computer readable medium of Claim 79, wherein said application mode is predefined.

82. A method executed in a computer apparatus for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of solving a set of partial differential equations comprising:

defining a plurality of user-defined application modes modeling physical quantities of an associated model;

selecting two or more of the user-defined application modes;

determining sets of partial differential equations for said selected two or more user-defined application modes of said associated model, parameters of the partial differential equations being physical quantities of an associated model; and

outputting a model based on a combination of the determined sets of partial differential equations for the two or more selected user-defined application modes for the associated model, whereby the model represents physical quantities of the combined physical system.

83. The method of Claim 82, further comprising:

solving for said set of partial differential equation using a finite element method.

84. The method of Claim 82, wherein said user-defined application mode is one of: a one-dimensional model, a two-dimensional model and a three-dimensional model.

85. The method of Claim 84, wherein said defining a user-defined application mode further comprises:

defining an object class corresponding to said user-defined application mode; and

defining a first portion of methods included in said object class using functionality that is inherited from other classes.

86. The method of Claim 85, further comprising:

overloading a second portion of methods to provide alternative functionality.

87. The method of Claim 86, further comprising:

using overloading in connection with at least one method to disable functionality of said at least one method.

89. The method of Claim 82, further comprising:

defining at least one user-defined application that is a subclass of an existing class associated with an application mode.

90. The method of Claim 89, wherein said application mode associated with said existing class is user-defined.

91. The method of Claim 89, wherein said application mode associated with said existing class is predefined.

92. A computer readable medium having stored thereon instructions for creating a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of solving a system of partial differential equations comprising machine executable code which when executed by at least one processor, causes the processor to perform steps comprising:

defining a plurality of user-defined application modes modeling physical quantities of an associated model;

selecting two or more of the user-defined application modes;

determining sets of partial differential equations for said selected two or more user-defined application modes of said associated model, parameters of the partial differential equations being physical quantities of corresponding systems; and

outputting a model based on a combination of the determined sets of partial differential equations for the two or more selected user-defined application modes for the associated model, whereby the model represents a mathematical expression of the physical quantities of the combined physical system.

93. The computer readable medium of Claim 92, further comprising:

solving for said set of partial differential equations using a finite element method.

94. The computer readable medium of Claim 92, wherein said user-defined application mode is one of: a one-dimensional model, a two-dimensional model and a three-dimensional model.

95. The computer readable medium of Claim 94, wherein said defining a user-defined application mode further comprises:

defining an object class corresponding to said user-defined application mode; and

defining a first portion of methods included in said object class using functionality that is inherited from other classes.

96. The computer readable medium of Claim 95, further comprising:

overloading a second portion of methods to provide alternative functionality.

97. The computer readable medium of Claim 96, further comprising:

using overloading in connection with at least one method to disable functionality of said at least one method.

98. The computer readable medium of Claim 97, further comprising:

selecting a plurality of application modes associated with at least one of a plurality of systems, said user-defined application being one of said plurality of application modes selected; and

forming a combined set of partial differential equations using sets of partial differential equations associated with said plurality of application modes.

99. The computer readable medium of Claim 92, further comprising:

defining at least one user-defined application that is a subclass of an existing class associated with an application mode.

100. The computer readable medium of Claim 99, wherein said application mode associated with said existing class is user-defined.

101. The computer readable medium of Claim 99, wherein said application mode associated with said existing class is predefined.

10. EVIDENCE APPENDIX

None.

11. RELATED PROCEEDINGS APPENDIX

None.